

Status of Technical Basis Development

A. INTRODUCTION

In a Staff Requirements Memorandum (SRM) dated August 18, 2000, the Commission decided to defer a final decision on whether to proceed with rulemaking on control of solid materials. In that SRM, the Commission directed the staff to proceed with a National Academies (NA) study on possible alternatives for control of solid materials and to also continue development of a technical information base necessary to support a Commission policy decision in this area.

The intent of the NRC's effort to develop a technical basis in this area is to be able to provide a complete analysis of a broad range of alternatives for control of solid material. As discussed in the Issues Paper (64 FR 35090, June 30 1999), principal factors included for analysis could include human health and environmental impacts, cost-benefit considerations, impacts on other industries, and the capability to survey the material for the various alternatives. To support this effort, technical information being developed in accordance with the SRM includes individual dose assessments, inventories of solid material potentially available for release, potential collective doses, the potential for exposure to multiple sources that could occur as a result of any releases, and costs associated with handling of these materials. It is also useful to have information on methods that could be used for performing radiation surveys of solid material available for release. The types of solid materials which are being analyzed as part of this effort are metals, concrete, soil, and other materials found at nuclear facilities, including rubbles and sediments, lead, glass, paper, wood, plastic, and ordinary trash.

Descriptions of the technical basis work are divided into four sections, each with the following format: (1) approach for technical information development; (2) work to date; and (3) future work plans.

B. ASSESSMENT OF INDIVIDUAL DOSES

1. Approach for Technical Information Development

As noted in the Issues Paper, a first step in the assessment of alternatives is to develop the capability to estimate the hypothetical dose an individual might receive as a result of the alternatives. To accomplish this first step, a report, "Radiological Assessments for Clearance of Equipment and Materials from Nuclear Facilities," Draft NUREG-1640, was published for public comment in March 1999. This report is only one piece of the overall technical bases described in Section A, above, and is limited in scope to assessing individual dose assessments resulting from possible recycle or reuse of material.

NUREG-1640 specifically assessed the scenarios, models, calculation methods, and results of such analyses for individuals over a broad range of scenarios for a control alternative in which materials would be permitted to be released at some to-be-established dose criteria. This was

determined to be an appropriate first step in NRC's effort because analysis of the "unrestricted release" alternative is likely to be a limiting case for dose analyses. Other alternatives were also suggested for study in the Issues Paper, including restricted release or prohibition of release, but are not explicitly addressed in NUREG-1640. It is intended that a broad range alternatives will be fully analyzed (see Section D below), however the analyses conducted in NUREG-1640 to date is useful for this broad range of alternatives based on the following:

- 1) With restricted release for some authorized use there is the potential that the "authorized" use may not be fully implemented and that unanticipated exposures could exceed the dose criterion for that release. For example, metal intended for an authorized use might be diverted to a more general use or could prematurely enter the general commerce pool of scrap metal, if the authorized use ended earlier than expected. The assurance that the material remains in its authorized use depends on the controls in place for the authorized use. Thus, the analyses contained in NUREG-1640 provides a bounding analysis which can be useful for restricted use scenarios.
- 2) The critical group (i.e., limiting scenario) for "restricted" use may be similar or identical to that for unrestricted use (as analyzed in NUREG-1640).
- 3) Another alternative, referred to in the Issues Paper as prohibition, would not permit release of materials from areas in a facility where radioactive materials are used or stored. Such an alternative would result in such material being directed to licensed disposal and the opportunity for exposures to recycled or reused material being minimal. Thus, detailed analysis of such scenarios for recycle or reuse, as done in NUREG-1640, is not needed for this alternative. Analysis of other impacts resulting from this alternative would be done as part of the overall evaluation of technical bases described in Section D below.

The scenarios analyzed in NUREG-1640 were designed to cover the probable fates of iron and steel, copper, aluminum, concrete and equipment for reuse if cleared to enter the general stream of U.S. commerce from a nuclear facility, and also to identify the group of individuals reasonably likely to receive the highest dose, i.e., the critical group. NUREG-1640 did not address certain materials available for release, such as wood, paper, glass, trash, soil, or other equipment and furniture, although analysis of these materials is being developed (see Section B.3, below).

2. Work to Date

Following publication of NUREG-1640 for public comment, there were a number of public comments provided to the Commission on NUREG-1640 at both the fall 1999 public meetings on the Issues Paper and in comment submittal specifically on NUREG-1640. There were a number of comments made on the technical content of NUREG-1640, including those related to modeling of materials in the steel melting process. There were also comments expressing overall concern with the validity of the report due to a potential conflict of interest by NRC's contractor; these commenters noted that the draft NUREG should be withdrawn.

In June 2000, a contract was awarded to the Center for Nuclear Waste Regulatory Analyses (CNWRA) to conduct an independent technical review of NUREG-1640. The CNWRA review of NUREG-1640, provided to the NRC in November 2000, found that NUREG-1640 was of high-

quality, but also provided suggestions for future work, including the addition of three exposure scenarios.

In July 2001, following a competitive procurement process, a contract was awarded to SC&A to address public comments and the independent CNWRA review, and to prepare a final version of NUREG-1640.

The work done to finalize NUREG-1640 has included an evaluation of several additional scenarios and subscenarios, in response to public and independent review comments, and the inclusion of dose factors for several additional radionuclides. This work has also involved reassessment of parameters and parameter distributions, as an integral part of responding to all comments. Where changes to the parameter or further explanation of their rationale are needed, they are planned for inclusion in the final version of NUREG-1640.

It is planned that a draft version of the revised NUREG-1640 will be provided for a peer review process by October 2002. Based on that review, a revised NUREG-1640 would be published in December 2002.

As part of its contract to consider possible alternatives for control of solid material, the NA reviewed NUREG-1640 along with other technical documents. The NA report noted that NUREG-1640 is considered state of the art in its risk assessment methodology and provides an in-depth analysis of recycling of steel, copper, aluminum and concrete with either volumetric or surficial contamination. The chemistry, metallurgy, geology, and physics appear sound technically and the conceptual plan of NUREG-1640 was found to be the best of all studies reviewed. A formal uncertainty analysis is incorporated into NUREG-1640, unlike the other studies. In response to a previous conflict of interest question, the NA committee noted that, from a scientific perspective, it does not believe it is cost-effective to repeat the work done in NUREG-1640. The mathematics and completeness of scenarios considered in NUREG-1640 have been verified through an audit carried out by another NRC contractor and the NA committee also carried out its own review that generally confirmed the reasonableness of several dose factor analyses. However, the NA did also note that a thorough review of the choice of parameters and parameter ranges, term by term, is needed to complete the reassessment of NUREG-1640. The NA report also noted that NUREG-1640 did not consider human error and its possible effect on dose factor predictions, nor did it consider scenarios involving multiple exposure pathways nor provide sufficient basis to analyze restricted use options. In considering these findings, the staff notes that it is involved in review and revision of various parameters and scenarios, but that several components of the technical basis indicated by the NA for inclusion in NUREG-1640 (e.g., multiple exposures) are actually broader in scope than NUREG-1640 and are being done as part of separate efforts (see Section D).

3. Future Work Plans

Further work to revise NUREG-1640 for metals and concrete, beyond that noted above, is not anticipated at this time. The individual dose conversion factors will be used in the work described in Section D below to develop additional dose and cost analyses.

Currently, individual dose factors are being developed for materials that could be available for release as part of routine operations at the variety of facilities NRC licenses, including hospitals, clinics, research, medical, and industrial laboratories, power plants, research reactors, and fuel facilities. Such materials include rubbles and sediments, lead, glass, paper, wood, plastic, and ordinary trash (a composite category of routine disposals for landfill). The dose conversion factors for these other materials is planned for inclusion as a Supplement 1 to NUREG-1640, anticipated for issuance in mid-2003.

C. ASSESSMENT OF INDIVIDUAL DOSES FOR SOILS

1. Approach for Technical Information Development

Section B describes the staff's analyses in NUREG-1640 of the hypothetical dose an individual might receive as a result of possible recycle or reuse of material. NUREG-1640 was limited in its analyses to metals and concrete. To provide similar information for decision-making for soil, the staff is developing a technical bases for estimating potential exposures if soil is cleared from NRC-licensed facilities. Like NUREG-1640, this is seen as a first step in evaluation of various alternatives for controlling release of this material. Section D below discusses analyses planned for assessment of all alternatives.

The first part of this effort included developing information on the ways in which soils are transported and/or reused in commerce (e.g., landscaping) or by the general public (e.g., rural residential gardening) in the U.S. This information is an integral part of the technical basis for assessing possible exposures that could result if soil is released from NRC-licensed facilities. Specifically, this information can be used in characterizing scenarios, estimating parameters, and selecting models for soils reuse for dose assessment. The second part of this effort was to conduct an analysis, similar to that in NUREG-1640, of scenarios, parameters, and resultant dose factors. This was broken into two steps: a preliminary dose assessment and a more detailed analysis of soil reuse.

2. Work to Date

As noted above, to aid in development of scenarios, parameters, and assumptions, and as the bases for specific parameters and their distributions, the NRC staff conducted an information search in cooperation with the U.S. Department of Agriculture's National Agricultural Library. In July 2000, draft NUREG-1725, "Human Interaction With Reused Soil: A Literature Search," documenting the initial search of available information sources and data and the process used to obtain this information, was issued for public comment. In January 2001, a focused search for additional information from internet, university, professional organization, and foreign sources was initiated. A final version of NUREG-1725 was issued in January 2002, which expanded the initial literature search and addressed public comments on draft NUREG-1725.

In February 2001, NRC began a preliminary dose assessment intended to provide a bounding analysis based on reasonable scenarios and parameters. Four scenarios were included in the preliminary assessment: (1) farm/field worker; (2) truck operator; (3) recreational user; and (4) rural resident baseline scenario for comparison purposes with technical support analysis done for the 1997 rulemaking on license termination. These scenarios were characterized, and

information for estimating parameter distributions was identified. The dose modeling was coordinated with similar dose modeling efforts for sewage sludge being conducted by the Interagency Steering Committee on Radiation Standards (ISCORS); and for metals and concrete in Draft NUREG-1640 to utilize established technical bases and common scenarios. This preliminary dose assessment, which was completed in January 2002, provided estimates of individual dose factors for soil reuse for the four scenarios. Based on the results of the preliminary analysis, a more detailed dose assessment was begun. One additional scenario was developed, additional coordination with the ISCORS subcommittee on sewage sludge was conducted, and parameters and calculation techniques were refined.

3. Future Work Plans

As part of the more detailed analysis of soils, additional soil reuse subscenarios are being characterized, and the initial scenarios and parameters are being refined. This assessment is planned for completion as a draft report for issuance for public comment in October 2002.

Further analysis regarding collective doses, the potential for exposure to multiple sources, and costs associated with alternatives for handling this material will be developed as part of the effort in Section D.

D. OVERALL ANALYSES OF ALTERNATIVES

1. Approach for Technical Information Development

As discussed in the Issues Paper, among the principal factors in making decisions regarding alternatives for control of solid material are human health and environmental impacts, cost-benefit considerations, impacts on other industries, resource conservation, and the capability to survey material. The Issues Paper also noted that, in assessing and making decisions on various potential alternatives, NRC would consider a broad range of possible impacts, both radiological and non-radiological, including evaluation of doses to individuals, assessment of collective doses to different population groups, impacts on biota, societal impacts, possible impacts on other industries, etc. Some of these impacts may be competing in that reduction in one impact could increase another impact. In addition, Executive Order 12291 requires Federal agencies, as part of their decision-making, to consider cost-benefit evaluations of alternative courses of action, including costs to licensees, the public, and other affected industries.

This staff effort is intended to provide a technical base for decision-making in the areas noted above. Information developed as part of an overall evaluation of various alternatives would include information on inventories of material potentially available for release, doses to individuals and doses to collective populations if that material were released, doses to an individual based on exposure to multiple items, and costs associated with various alternatives. As described in Sections B and C of this attachment, one part of this information base, i.e., the analyses of doses to an individual based on exposure to a single item, has been completed in draft form in NUREG-1640. The additional analyses noted here are ongoing as part of this effort.

2. Work to Date

Inventory estimates are being developed for materials that could be available for release as part of routine operations at the variety of facilities NRC licenses, including hospitals, clinics, research, medical, and industrial laboratories, power plants, research reactors, and fuel facilities as well as at U.S. Department of Energy (DOE) and U.S. Department of Defense (DOD) facilities, and facilities that handle technologically enhanced naturally occurring radioactive materials. This includes four categories of materials analyzed in NUREG-1640, ferrous metals, aluminum and its alloys, copper and its alloys and concrete. It also includes rubbles and sediments, lead, glass, paper, wood, plastic, and ordinary trash.

3. Future Work Plans

Information on the inventory of materials at NRC-licensed facilities, which are potentially available for release, is planned for publication as a draft NUREG in September 2002.

An analysis of potential exposures of an individual to multiple sources made from recycled materials from licensed facilities is planned for publication as a draft NUREG in December 2002.

Collective doses to the population which could result from any of the alternatives for control of the various materials, discussed above, are being developed based on the individual doses discussed in Section B. It is anticipated that the collective dose analyses would be published in mid-2003.

Cost information for the alternatives and materials being considered would be developed based on material inventory and dose assessments.

E. SURVEY METHODS

1. Approach for Technical Information Development

As part of decision-making on alternatives for control of solid materials, it is useful to have information on methods that could be used for performing radiation surveys to control solid material. The extent of the radiation survey of solid materials at nuclear facilities is dependent on the various alternatives under consideration but the objective in each case is the same, i.e., to assure protection of public health and safety by assuring that criteria are being met.

During the 1990's, there was an interagency effort to improve the planning, conducting, evaluating, and documenting of radiological surveys of building surfaces and surface soil. This effort included the preparation of NUREG-1505, "A Nonparametric Statistical Methodology for the Design and Analysis of Final Status Decommissioning Surveys," and NUREG-1507, "Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions" by the NRC and culminated with the issuance of Multi-Agency Radiation Survey and Site Survey Manual (MARSSIM) (published by NRC as NUREG-1575) which was a joint effort by NRC, DOD, DOE, and the U.S. Environmental Protection Agency (EPA). MARSSIM is a consistent approach for planning, performing, and assessing the ability of surveys to meet standards while at the same time encouraging effective use of resources. MARSSIM provides

guidance on developing appropriate survey designs using the Data Quality Objectives (DQO) process to ensure that survey results are of sufficient quality and quantity to support a final decision.

The staff's current effort in this area is developing technical information on survey approaches for a range of possible alternatives for control of solid material. It provides information on surveys associated with alternatives where material would not be released, as well as surveys for a range of nuclide concentrations for alternatives where material would be released.

Work being done as part of this effort assesses how the DQO process would need to be extended to the design and implementation of surveys if solid materials were released from licensed facilities. This information is important to assure that, for any of the alternatives where material could be released, material being released meets the standard that is set. In addition, it addresses the need for increased survey complexity to allow for the ability to distinguish actual material levels from background.

The alternative of not permitting material to be released if it is located in an area where radioactive materials are used or stored, referred to in the Issues Paper as prohibition, would rely principally on process knowledge of where the material had originated because it would use that information as a basis for determining disposition of the material. Information on process knowledge is developed as part of this effort. This alternative would not be as dependent upon detailed methods for radiological surveys and thus much of the information developed as part of this effort would not be applicable to this alternative. The alternatives of continuing current practice or permitting release using dose-based criteria rely upon process knowledge of where the solid materials originate in the facility, as well as comprehensive radiological surveys to demonstrate that the level of radioactivity on the material would meet the required criteria. Information on various survey methodologies are being developed to ensure that criteria for control of solid material could be reliably met. The alternative of restricted use may use process knowledge to determine those materials that would be limited to authorized uses but may be similar to unrestricted use in the need for comprehensive surveys.

An program, Spatial Analysis and Decision Assistance (SADA), was developed by DOE and EPA to implement MARSSIM concepts in November 1999. SADA provides a number of integrated tools in geospatial modeling, spatial analysis, visualization, statistical analysis and sampling design.

2. Work to Date

Coordinated efforts are continuing on clearance survey procedures using common off-the-shelf instrumentation and on advanced instrumentation and analytical approaches for the assay of residual radioactivity in, and on, solid materials. Information from these efforts is planned for inclusion in a draft NUREG entitled, "Radiological Surveys for Controlling Release of Solid Materials," in July 2002.

To support the overall analysis of alternatives discussed in Section D, in particular with regard to cost-benefit analyses, a draft NUREG entitled, "Clearance Survey Costs" for various alternatives under consideration is being prepared.

A proof-of-concept test to determine the feasibility of using a statistical methodology to evaluate subsurface concentrations was conducted. The results indicated that it is feasible and NRC plans to develop detailed methodologies.

3. Future Work Plans

As noted above, the staff has worked previously with other Federal agencies to develop the MARSSIM. MARSSIM was developed to deal with issues associated with making radiological measurements at low levels, but was limited to surface contamination in buildings and land areas. MARSSIM currently does not address subsurface contamination measurements or volumetric contamination in soils, materials and equipment. NRC staff is considering a plan to work with other Federal agencies to revise MARSSIM to address these limitations. In addition, NRC has initiated the development of optimized statistical methodologies to evaluate subsurface concentrations in soil based on the successful feasibility test. The methodology will add components to previously developed components of SADA. These efforts can provide useful information independent of the alternative for control of solid material chosen.